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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/098,760
Filing Date ..... June 17, 1998
Inventor ..... R.P. Shah
Assignee ..... Johnson Matthey Electronics, Inc.
Group Art Unit 1753
Examiner ..... S. Versteeg
Attorney's Docket No. 32120
Title: Tantalum-Comprising Articles (as amended)

DECLARATION OF RITESH P. SHAH, PH.D.

I, RITESH P. SHAH, declare as follows:

1. I am one of the named inventors in the above-identified application.

2. I have a Bachelor of Science Degree from M.S. University of Baroda, India; a M.S. Degree in Ceramic Science from New York State College of Ceramics, at Alfred University; and a Ph.D. in Metallurgy from the Georgia Institute of Technology.

3. I have read and am familiar with the Ohhashi et al. references (U.S. Patent No. 5,693,203; EP Application No. 0590504A1); Oikawa et al. (U.S. Patent 4,619,695); and the Wright et al. article cited by the Examiner against the claims in the present application.

4. I note that a difference between my claimed invention and the disclosures of the Examiner's cited references is that my invention is directed toward tantalum materials having substantially uniform (100) crystallographic orientation, and a maximum grain size less than 50 microns; whereas the cited references do not disclose any specific

tantalum materials having substantially uniform crystallographic orientation and a maximum grain size less than 50 microns.

5. I have noted that the Ohhashi reference 5,693,203 discloses tantalum materials, and also states that such materials have grain sizes of no more than 350 microns. However, I further note that there is no specific example in Ohhashi of a tantalum material having a grain size less than 50 microns.

6. There are a number of advantages to reducing grain size in tantalum materials. For instance, if the tantalum materials are utilized as sputtering targets, smaller grain sizes can enable better uniformity to be formed across a target surface. The better uniformity across the target surface can improve uniformity of thin films deposited from the target relative to thin films deposited from a target having larger grain sizes. In other words, the quality of a thin film formed on a substrate by a sputtering method can be influenced by the grain size of a target material used for the sputtering, with smaller grain sizes leading to improved qualities of sputter-deposited thin films. As an example of how larger grain sizes can adversely influence sputter deposition, it is noted that when protrusions of grain material are present on a sputtering target surface, an abnormal discharge (so-called micro-arcing) can be caused at the protrusions. The abnormal discharge can result in macro-particles being scattered out from the surface of the target material, and deposited onto a substrate along with a thin film that is intended to be

sputter-deposited on the substrate. The deposited macro-particles can cause blobs on the thin film and result in short-circuiting of semiconductor thin film circuits incorporating the sputter-deposited thin films. The deposited macro-particles are known as "particles" or "splats" in the art. An advantage of reducing crystal grain size is that a surface roughness of a target material can be reduced by reducing grain size within the target material. Accordingly, by reducing the size of crystal grains existing within a target material, it is possible to prevent the generation of "splats", thereby allowing better quality films to be formed than can be formed from targets having larger grain sizes.

7. Of "critical" importance in my claimed invention is that the claimed tantalum grain sizes are less than 50 microns. Grain sizes of less than 50 microns can significantly improve surface properties of articles formed from the tantalum materials, and specifically can improve sputtering targets formed from the tantalum materials, relative to targets formed from tantalum materials having larger grain sizes. My claimed grain sizes of less than 50 microns can lead to substantially improved targets relative to targets having larger grain sizes. There is no indication in U.S. Patent 5,693,203 that a tantalum material was ever produced having a grain size as low as 350 microns. Regardless, even if a tantalum material were produced, my claimed invention is a substantial improvement over such material in that my invention achieves a grain size only one-seventh as large as the disclosed 350 microns,

specifically, my invention which is disclosed and claimed is to a tantalum material having a grain size of 50 microns or less. For the reasons described above, a tantalum material having a grain size of 50 microns or less is significantly improved for forming particular tantalum articles, such as, for example, sputtering targets, relative to tantalum materials having larger grain sizes.

8. I have noted that European patent application 0590904A1 to Ohhashi describes subject matter similar to the above described U.S. patent, 5,693,203; but refers to targets having grain sizes less than 100 microns (claim 12). There is no indication in EP 0590904A1 that a tantalum material was ever produced having a grain size as low as 100 microns. Regardless, even if a tantalum material were produced with a grain size as low as 100 microns, my claimed invention is a substantial improvement over such material in that my invention achieves a grain size only half as large as the disclosed 100 microns, specifically, my invention which is disclosed and claimed is to a tantalum material having a grain size of 50 microns or less. For the reasons described above, a tantalum material having a grain size of 50 microns or less is significantly improved for forming particular tantalum articles, such as, for example, sputtering targets. Therefore my claimed materials has substantially improved properties relative to tantalum materials having grain sizes even as low as 100 microns.

9. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon.

7/12/00
Date

Ritesh P. Shah